

SPECIALISTS IN IDENTIFICATION SOLUTIONS



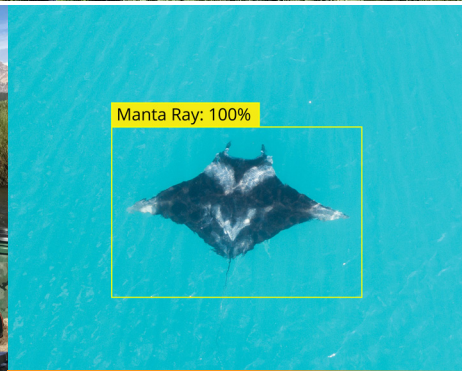
**Biomark**

# STUDY DESIGN

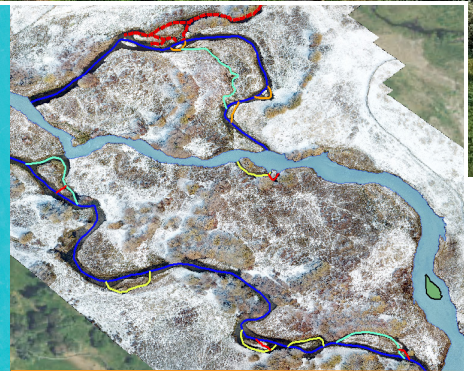
ENHANCING EFFICIENCY & INFERENCE



**OPTIMIZED SAMPLING**



**APPLIED ANALYTICS**



**DATA VISUALIZATION**

Data are expensive, rarely perfect, and often unavailable for locations and populations of interest; nonetheless decisions must be made. Biomark researchers specialize in applied science, increasing efficiency at each step of the scientific method. We leverage a team of diverse research backgrounds to capitalize on sampling opportunities to extend inference, develop statistical approaches with quantitative measures of uncertainty, combine imperfect data sources to reduce bias, and produce static and interactive data visualization products that directly inform management decisions. We deliver high quality data, analytics, and visualizations designed to eliminate costs while maintaining the broadest application. The applied biological services, technical services, engineering, and sales staff have over 150 years of combined experience to help maximize the success and application of studies at any scale.

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# FEATURED PROJECT

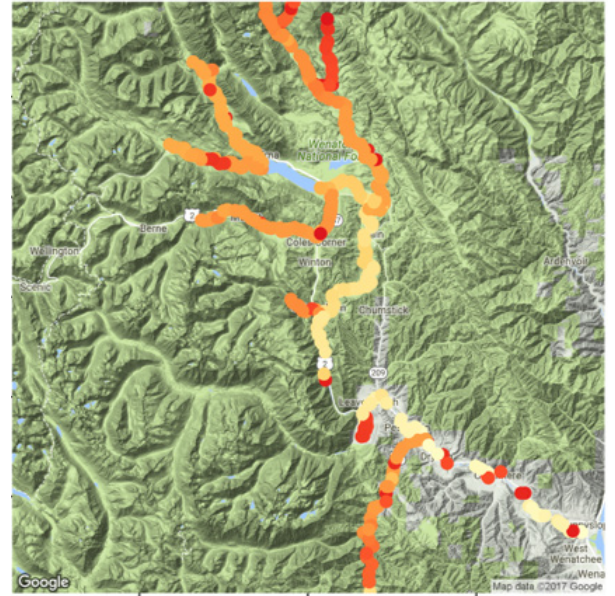
## INTEGRATED STATUS AND EFFECTIVENESS MONITORING PROGRAM (ISEMP)

Declines in Pacific salmonid populations prompted the need to establish standardized population and habitat monitoring across the Columbia River Basin. The vast spatial scale and challenges such as access to private land significantly complicated sampling design efforts. Starting in 2003, Biomark researchers embarked on a fifteen-year project to design, apply, and evaluate an efficient, robust sampling strategy to monitor endangered salmonid populations and their habitat. Employing advanced statistical techniques such as an inverse probability bootstrap and generalized random-tessellation stratified (GRTS) sampling design allowed for the accommodation of inaccessible locations while accounting for the statistical needs of the project. The need to efficiently sub-sample in space and time with the ability for broad extrapolation inspired a number of Biomark data collection and analysis products including PITcleanr, State-space Adult Dam Escapement Model (StADEM), Dam Adult Branch Occupancy Model (DABOM), Quantile Random Forest (QRF) capacity modeling, and the Drone Assisted Stream Habitat (DASH) protocol.

Biomark researchers collaborated with a variety of stakeholders, funding agencies, and research organizations including the Bonneville Power Administration, National Oceanic and Atmospheric Administration, Idaho Department of Fish and Game, the Nez Perce Tribe, and private land owners to design and implement a large-scale, standardized, quantitative fish-habitat assessment for the Columbia River Basin. The wealth of publicly available data generated by this study is frequently used to assess long-term habitat and population trends and evaluate the effectiveness of conservation and restoration actions.

Biomark products, technology, and services used for this project:

- Study Design
- Data Reduction, QA/QC
- State-space modeling
- Patch occupancy modeling
- QRF Modeling
- DASH Protocol
- Imagery Processing
- Fish & Habitat Sampling



Quantile Random Forest (QRF) habitat capacity modeling and extrapolation was developed by Biomark researchers to extend the statistical inference of fish and habitat data



Quality data are costly. Biomark researchers specialize in optimizing data collection and analysis opportunities to increase efficiency and expand inference.

# OTHER PROJECT APPLICATIONS

